

# Harmonized Growth Models and Simulations of the Evolution of Pure Stands of Norway spruce, Larches and Douglas-fir for Southern Belgium (Wallonia).

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## Introduction

Forest growth models are used to predict stand development based on various factors: species composition, site characteristics and silvicultural management. These models are important to compare the likely effects of various management scenarios on the development of forest resources in order to identify those who meet the requirements of the owners.

Gembloux Agro-Bio Tech (GxABT) is working on several growth models to be implemented into modules for the simulation platform CAPSIS (Computer-Aided Projection of Strategies In Silviculture - <http://capsis.cirad.fr>). GYMNOS is one of these modules and its main purpose is to provide accurate tools for comparison and growth simulations for even-aged stands of Norway Spruce (*Picea abies*), Douglas-fir (*Pseudotsuga menziensis*), and Larches (*Larix decidua* and *Larix kaempferi*).

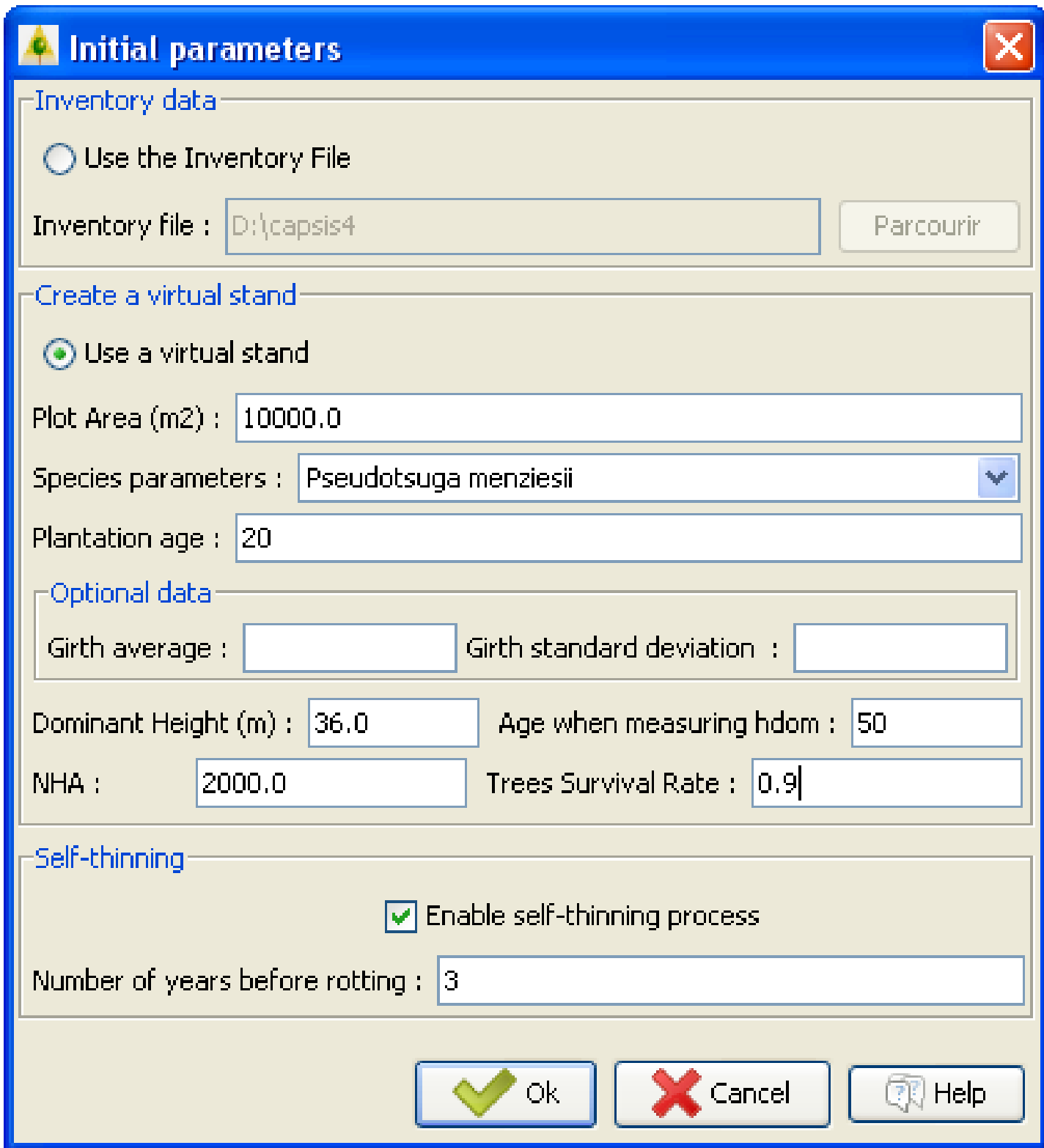
## Material and method

Data were collected from 1414 permanent plots of the regional forest inventory of Wallonia, 827 temporary and semi-permanent plots installed by GxABT and 291 stem analysis. Several datasets were selected to give a good representation of sites characteristics and stand densities variability encountered in even-aged pure coniferous stands of southern Belgium.

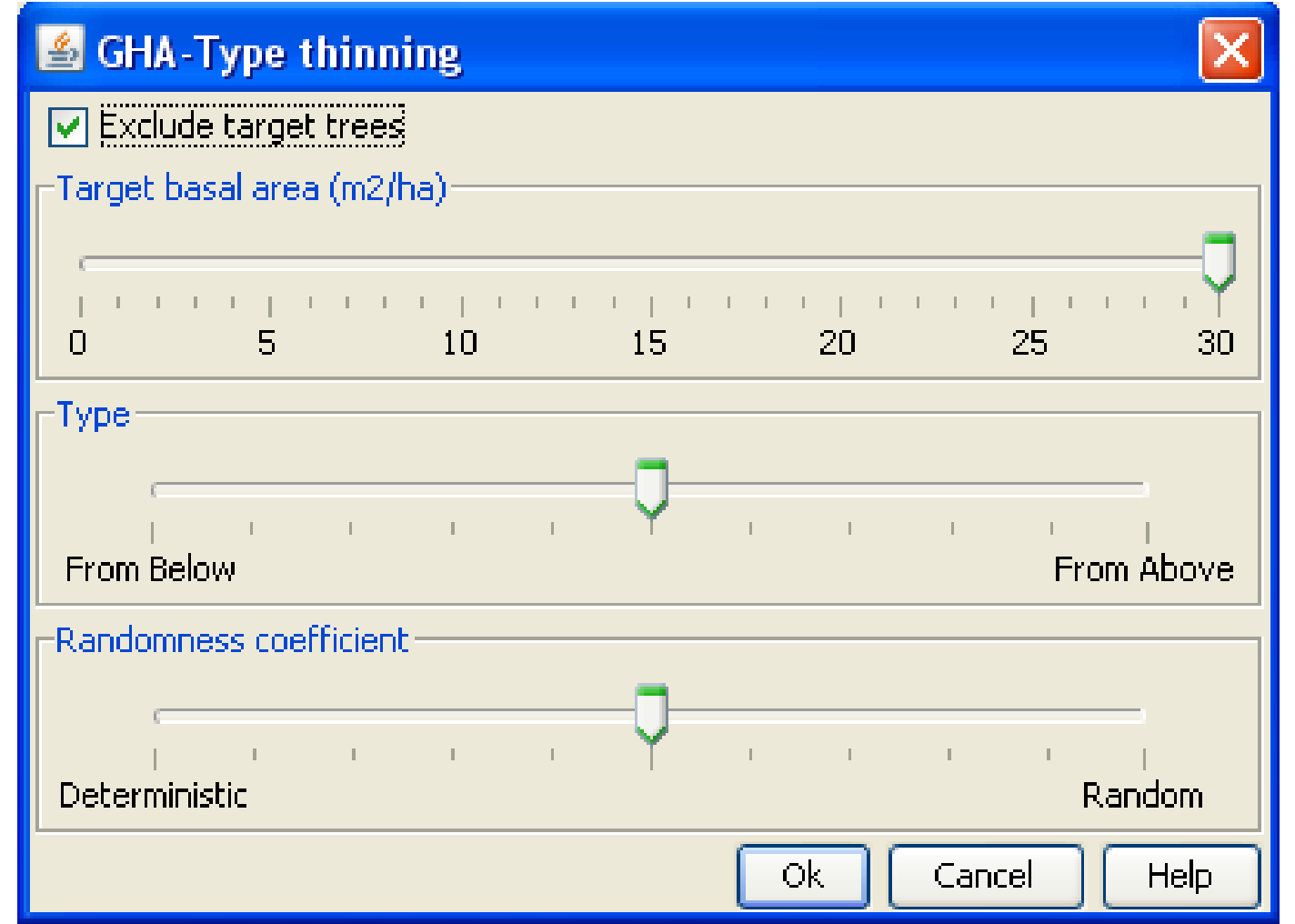
Harmonized and distance-independent models of dominant-height and tree diameter growth, self-thinning, and distribution of tree diameter frequency before the first thinning were then adjusted on selected datasets using generalized nonlinear regression with the nlme package in R software (R Development Core Team 2007). This procedure allows to test species effect on parameters values of each models and therefore simplifies comparisons between species.

## Examples of simulations in GYMNOS

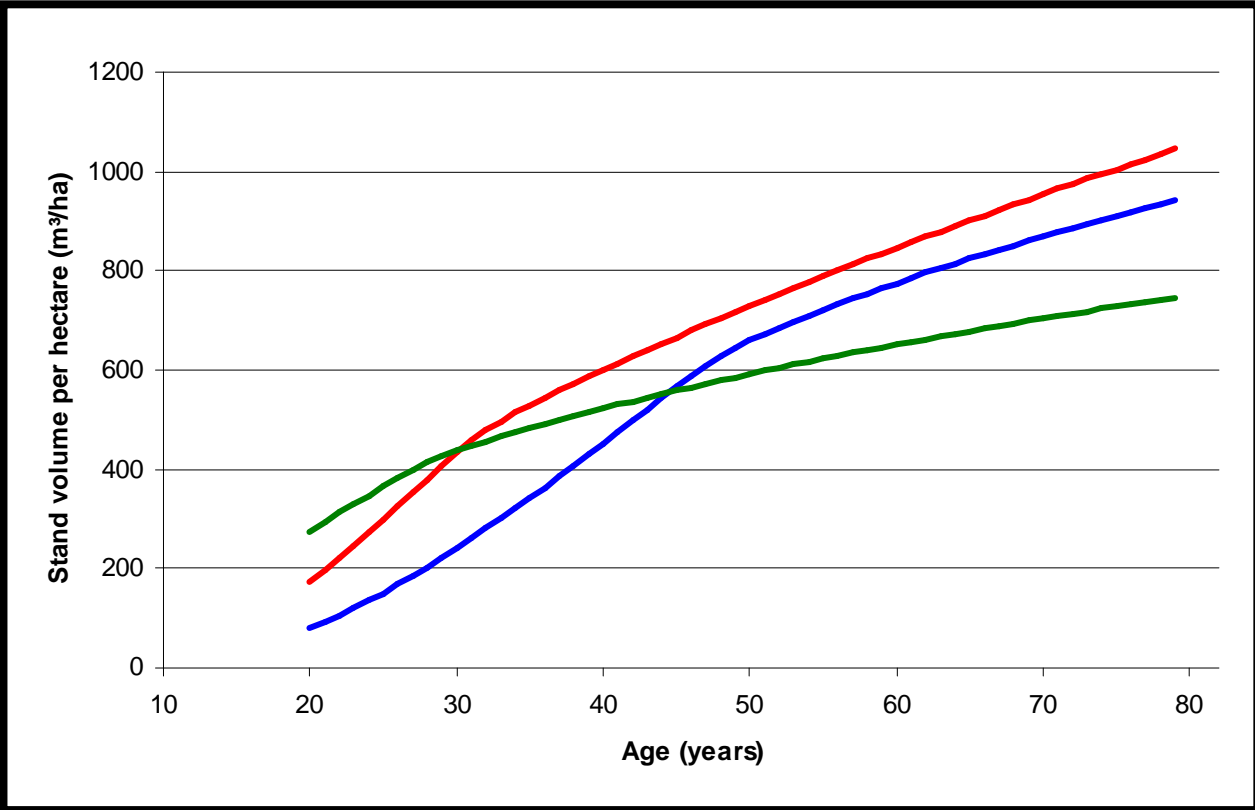
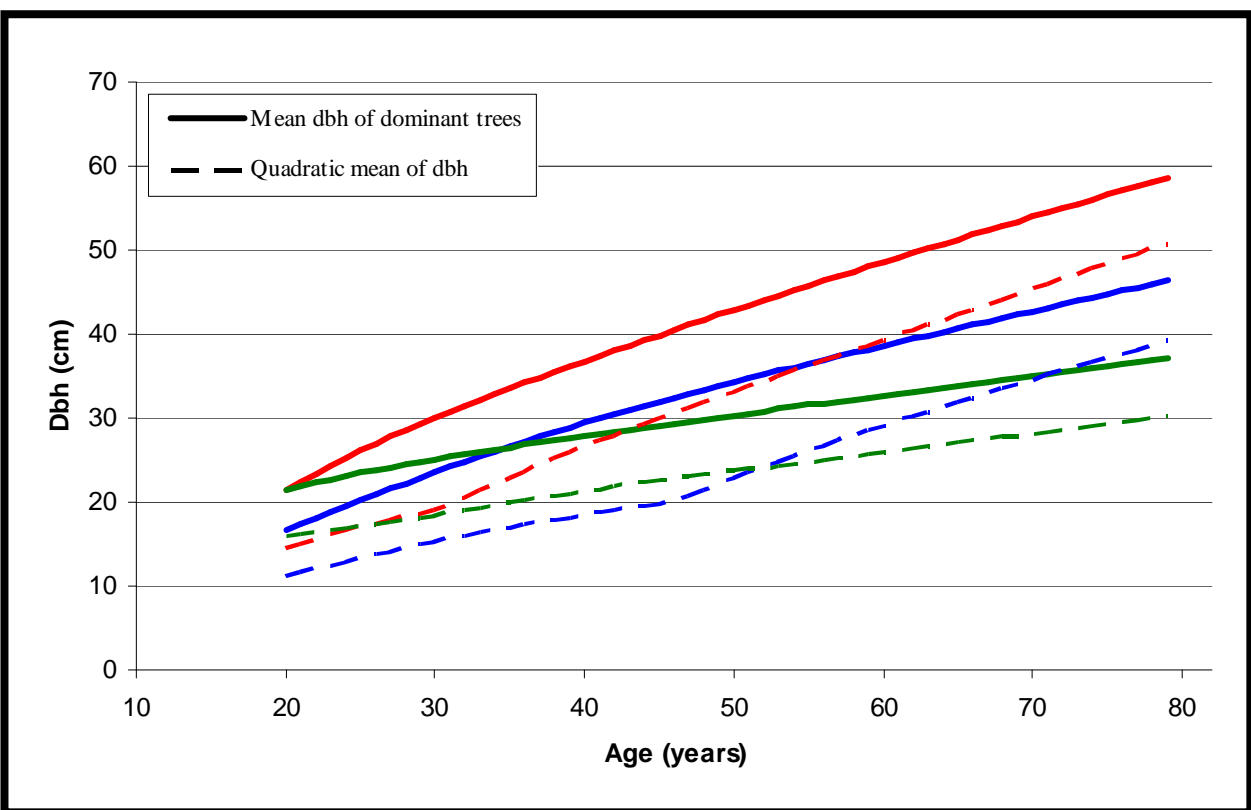
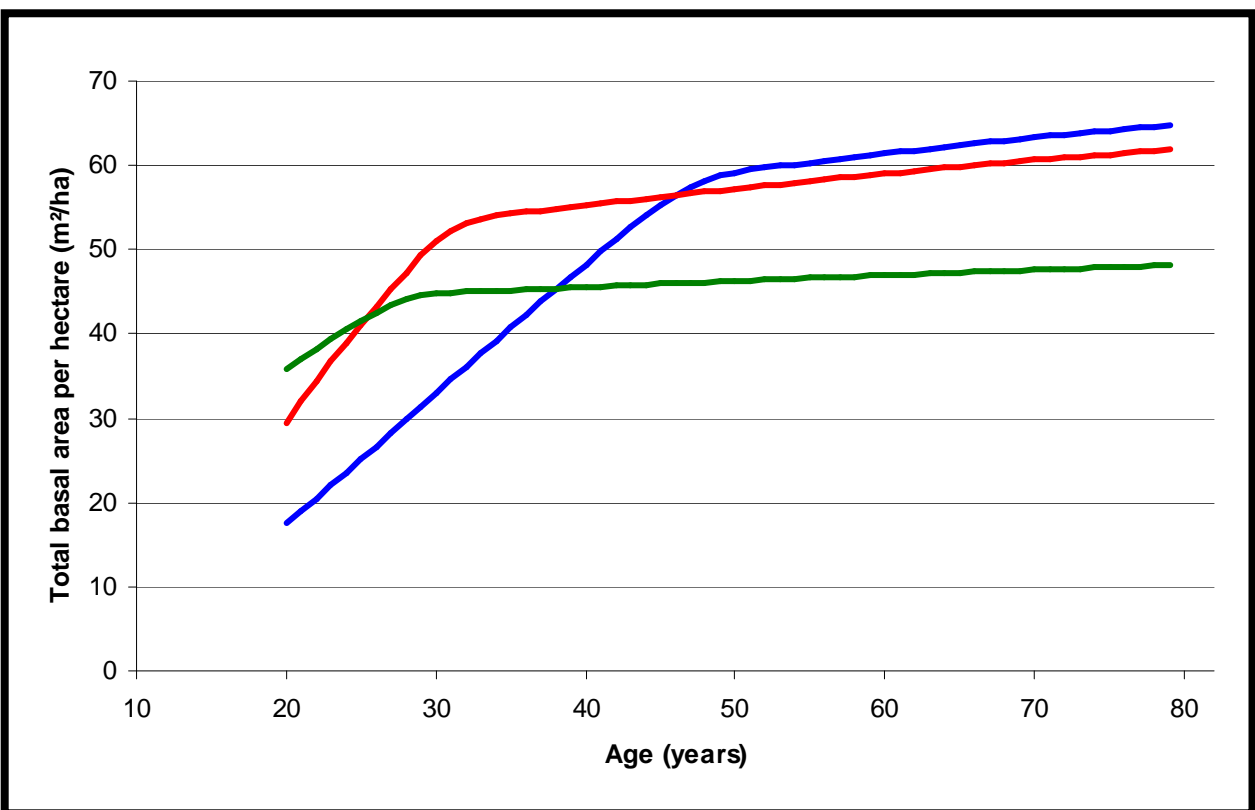
Stand creation interface



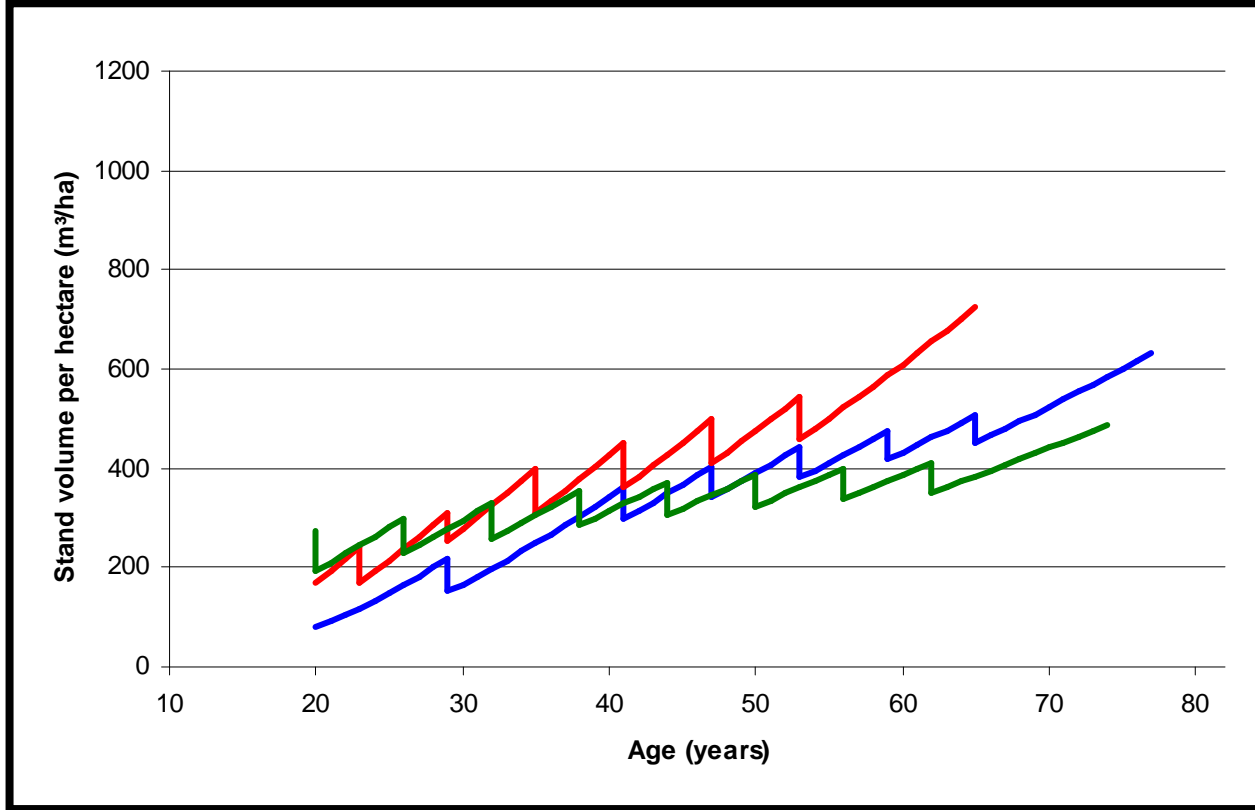
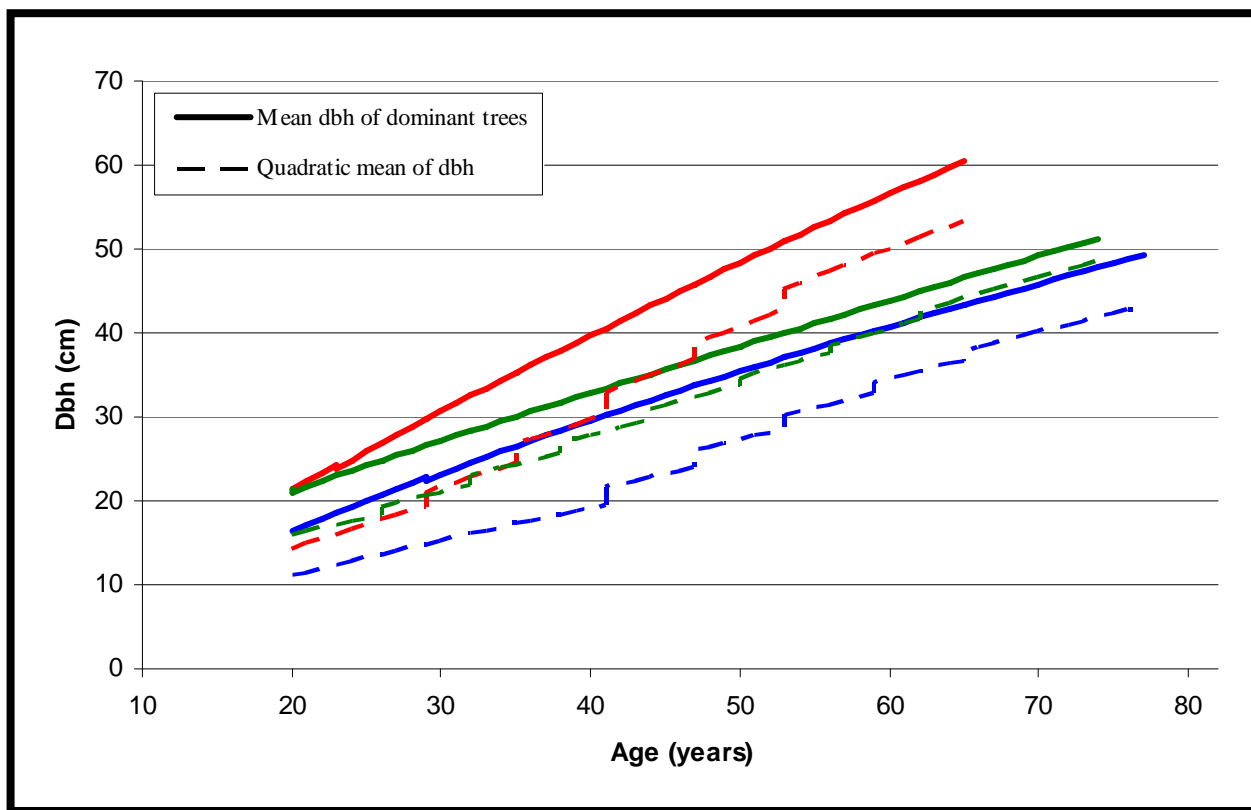
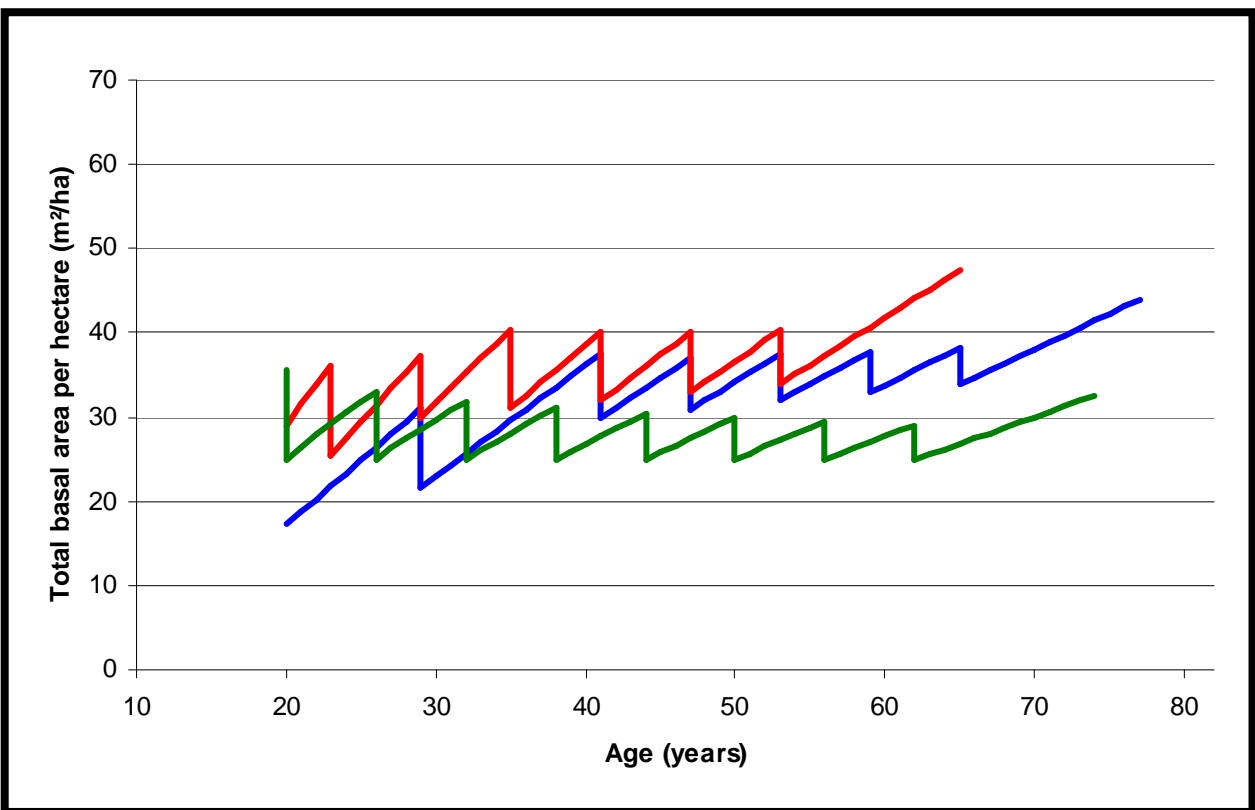
Stand thinning interface



Self-thinned stand



Example of silvicultural management



The initial stands parameters chosen for these examples represent usual planted stands of Wallonia. Site index have been selected to represent the most common site characteristics of southern Belgium forests and allow relevant comparisons between species. The self-thinning simulations highlight the great sensitivity of Larches to stand density while Norway spruce and Douglas-fir seem able to sustain their increment rate despite high stand density. The example of silvicultural management simulations show that Norway spruce and Larches are less productive than Douglas-fir.

## Discussion

Models employed require further validation and improvements to be relevant in some unusual situation and for under 20 years stands. Nevertheless those simulations highlights interesting species traits and the need of specific silvicultural scenarios for each species.

Once completed, GYMNOS will be used to optimize silvicultural management techniques and to predict medium and long term changes in softwood forest resources of Wallonia.

## Perspectives

Further improvement of GYMNOS:

- enhancement of the validity of the models employed;
- implementation of wood quality and economical process;
- prediction of potential productivity from site characteristics.